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REMARKS

5 This amendment is respectfully submitted to place subject Application in condition for allowance by to more distinctly claiming the subject matter of the invention. New Claim 26 has been provided herewith for examination. Claim 15 has been amended to recite the limitations of dependent Claim 16, which has been canceled. Claim 21 has been amended to include treating of the separated peracid-containing phase according to Claim 23, which has been amended to depend from Claim 26.

10 New Claim 26 is directed to Applicants' novel process for the production of refinery transportation fuel or blending components for refinery transportation fuel, which process comprises:

15 hydrotreating a petroleum distillate consisting essentially of material boiling between about 50° C. and about 425° C. by a process which includes reacting the petroleum distillate with a source of hydrogen at hydrogenation conditions in the presence of a hydrogenation catalyst to assist by hydrogenation removal of sulfur and/or nitrogen from the hydrotreated petroleum distillate;

20 fractionating the hydrotreated petroleum distillate by distillation to provide at least one low-boiling blending component consisting of a sulfur-lean, mono-aromatic-rich fraction, and a high-boiling feedstock consisting of a sulfur-rich, mono-aromatic-lean fraction;

25 contacting at least a portion of the high-boiling feedstock with an immiscible aqueous phase having a water content of less than 60 percent by volume and comprising at least one organic peracid or precursors of organic peracid, in a liquid reaction mixture maintained substantially free of catalytic active metals and/or active metal-containing compounds and under
30 conditions suitable for oxidation of one or more of the sulfur-containing and/or nitrogen-containing organic compounds at temperatures in a range upward from about 50° C. to about 150° C.;

separating at least a portion of the immiscible peracid-containing phase from the reaction mixture to recover an essentially organic phase from the reaction mixture; and

5 treating at least a portion of the recovered organic phase with a solid sorbent, an ion exchange resin, and/or a suitable immiscible liquid containing a solvent or a soluble basic chemical compound, to obtain a product containing less sulfur and/or less nitrogen than the feedstock.

10 Support for new Claim 26 is found in the Specification (see Examples 3 to 6 at page 30, line 23 to page 32, line 9) and Claims 21 and 23.

15 Attention of Examiner is invited to instant Claim 15 that was previously amended to recite the step of contacting all or at least a portion of the recovered organic phase with at least one immiscible liquid comprising a solvent having a dielectric constant suitable to selectively extract oxidized sulfur-containing and/or nitrogen-containing organic compounds. More particularly, instant Claim 15 now recites the process according to claim 12 wherein the solvent has a dielectric constant in a range from about 24 to about 80.

20 In view of the amendments submitted herein and previous filed papers, it is the position of Applicants that Claims 12, 14, 15, 17 to 25 inclusive, all claims now presented, are in condition for allowance.

Claim Rejections - 35 U.S.C. § 103

25 In the outstanding Office Action, Claims 12 and 14 to 25 were rejected under 35 U.S.C. § 103(a), as being unpatentable over U.S. Patent No. 6,217,748 in the name of Shigeto Hatanaka, Osamu Sadakane, and Hideshi Iki and assigned to Nippon Mitsubishi Oil Corp. (JP), (Hatanaka et al.), in view of U.S. Patent No. 1,972,102 in the name of William M. Malisoff (Malisoff), U.S. Patent No 3,341,448
30 in the name of John Frederick Ford, Timothy Arrowsmith Rayne

and Dennis George Adlington (Ford et al.), U.S. Patent No. 6,274,785 in the name of Walter Gore (Gore), and either GB 2262942A, or U.S. Patent No. 3,163,593 in the name of Alfred Bentley Webster, Norman James Herbert, and Richard Rigby (Webster et al.).

5 Applicants respectfully traverse these rejections.

The Hatanaka et al. reference of record describes a four-step hydrodesulfurization (HDS) of a sulfur-containing petroleum hydrocarbon diesel gas oil. The diesel gas oil of Hatanaka et al. appears to be free of deleterious nitrogen heteroaromatic
10 compounds, because the presence of nitrogen is not disclosed or suggested.

The gas oil is catalytically hydrodesulfurized at 300° C. to about 500 ppm sulfur in a first HDS step. Step two is distillation at a cut point temperature in a range of 320 to 340° C. Step three is a
15 second HDS of only the heavy fraction of the distillation at up to 380° C. The twice hydrodesulfurized heavy fraction (90 ppm sulfur) is mixed with the light fraction of the distillation (10 ppm sulfur) to a sulfur content of up to 0.01% (100 ppm sulfur). For example, a product having 50 ppm sulfur is reported by Hatanaka
20 et al. as Example 3.

Treatment of the gas oil, or any hydrodesulfurized product thereof, to thereby obtain a product containing less sulfur **and** less nitrogen than the feedstock, is not disclosed or suggested in the Hatanaka et al. reference of record.

25 By contrast, all products of an alumina treatment according to Applicants' Example 14 had a sulfur concentration of less than 3 ppm, and in general 1 ppm sulfur.

Obvious disadvantages of the Hatanaka et al. process include the costs of the additional hydrogen and energy required for both
30 the distillation and further hydrodesulfurization steps. While

Hatanaka et al. state the hydrogen sulfides from the two HDS steps may be removed from the off-gas by an amine absorption arrangement, carbon oxides are also by-products of the HDS steps. Generation of the additional hydrogen also produces more carbon dioxide. These are especially critical at a time when most industries are striving to limit the amount of emitted "green house" gas such as carbon dioxide.

Less obvious disadvantages of the second HDS in the Hatanaka et al. process include a loss of non-sulfur multi-ring aromatic hydrocarbons to saturated non-aromatic ring compounds. This has negative fuel property/quality consequences such as affecting the pour point, reducing the lubricity, and reducing the fuel value (Btu/volume) of diesel fuel. A diesel fuel rich in aromatics have a higher Btu/volume and give more miles per gallon.

Contacting feedstock, or any fraction thereof, with an immiscible aqueous phase comprising at least one organic peracid or precursors of organic peracid, in a liquid reaction mixture maintained substantially free of catalytic active metals and/or active metal-containing compounds and under conditions suitable for oxidation of one or more of the sulfur-containing and/or nitrogen-containing organic compounds, as recited in instant Claim 21, or any other oxidation step, is not disclosed or suggested in the Hatanaka et al. reference of record.

The oxidation step in Applicants' novel process is very specific in the targeting of sulfur hetroaromatic compounds. Oxidation of these offending sulfur hetroaromatic compounds is selective and other aromatic hydrocarbons not containing sulfur or nitrogen are unaffected by the process.

It is the position of Applicants that the Malisoff reference of record teaches a treatment for removal of sulfur from hydrocarbon oil by treating a hydrocarbon oil with a miscible treating solution

containing a concentrated water solution of hydrogen peroxide and sufficient quantity of acetic acid to render the treating solution miscible with the oil, and **thereafter** adding an equivalent volume of water to obtain a resulting dilute aqueous phase which separates
5 from the treated oil phase (Malisoff, for example, at page 1, lines 49 to 59, and page 2, lines 3 to 5). In example 1 of Malisoff, the resulting dilute aqueous phase containing more than 60 percent water (calculated without including any water formed by reaction of hydrogen peroxide).

10 Applicants respectfully submit that, at the time they made their novel invention, one skilled in the relevant art would not have found in the total reading of the Malisoff reference of record a teaching that the treating solution "need not have at least" partial oil solubility as stated by Examiner.

15 By contrast, instant claims include a key step of contacting a high-boiling, sulfur-rich, mono-aromatic-lean, petroleum distillate fraction with an immiscible phase comprising at least one organic peracid or precursors of organic peracid in a liquid phase reaction mixture. Maintaining the reaction mixture substantially free of
20 catalytic active metals and/or active metal-containing compounds and under conditions suitable for oxidation of one or more of the sulfur-containing and/or nitrogen-containing organic compounds including temperatures in a range upward from about 50° C. to about 150° C. are recited elements of the invention. Blending
25 components containing less sulfur and/or less nitrogen than the oxidation feedstock are recovered from the reaction mixture.

Instant claims recite that at least a portion of the immiscible peracid-containing phase is recovered from the reaction mixture; treated to remove at least a portion of the sulfur-containing and
30 nitrogen-containing organic compounds and water contained therein, and thereafter recycling to the reaction mixture at least a portion of the treated peracid-containing phase having a water

content of less than 60 percent by volume; and recycled into the oxidation.

5 Integrated processes of this invention may also provide their own source of high-boiling oxidation feedstock derived from other refinery units, for example, by hydrotreating a petroleum distillate. It is the position of Applicants that their novel processes differ in kind, not merely in degree, from the process described in the Malisoff reference of record.

10 Applicants agree with Primary Examiner Griffin that several critical elements of their novel process, as recited by the instant claims, are not disclosed or suggested in the Malisoff reference of record.

15 However, it is the position of Applicants that, without extensive and impermissible use of hindsight, one skilled in the art at the time the novel invention was made should not have found in the references of record relied upon by Examiner disclosure or suggestion of the process according to the instant claims.

20 Oils treated according to examples in the Malisoff reference of record initially contained sulfur at levels of 0.21, 1.12, and 0.25 percent sulfur. However the products of the Malisoff treatments, resulted in products containing sulfur levels of 0.16, 0.88 and 0.10 percent sulfur (1,600 ppmw, 8,800 ppmw and 1,000 ppmw). These levels of sulfur are very high in view of sulfur specifications for transportation fuels. Legislation on sulfur in diesel fuel in Europe, 25 Japan and the U.S. has recently lowered the specification to 0.05 percent by weight maximum sulfur in Diesel fuel, and indications are that future specifications may go far below the current 0.05 percent by weight level.

By contrast, all products of an alumina treatment according to Applicants' Example 14 had a sulfur concentration of less than 3 ppmw, and in general 1 ppmw sulfur.

By means of the contacting in Applicants' novel process, the
5 tightly substituted sulfides are oxidized into their corresponding
sulfoxides and sulfones with negligible if any co-oxidation of
mononuclear aromatics. These oxidation products due to their high
polarity, can be readily removed by separation techniques such as
10 sorption, extraction and/or distillation. The high selectivity of the
oxidants, coupled with the small amount of tightly substituted
sulfides in hydrotreated streams, makes the instant invention a
particularly effective deep desulfurization means with minimum
yield loss. The yield loss corresponds to the amount of tightly
15 substituted sulfides oxidized. Since the amount of tightly
substituted sulfides present in a hydrotreated crude is rather
small, the yield loss is correspondingly small.

It is the position of Applicants that the Malisoff reference of
record, taken alone or in combinations relied upon by Examiner,
20 does not suggest the essence of their novel multi-step process as
recited according to instant Claims 12, 14, 15, 17 to 26 inclusive.

Attention of Primary Examiner Griffin is invited to consider
the paper cited in Paper No. 12. Danping Wei and H. A. Spikes
reported results of their investigation of the main chemical factors
influencing the lubricity of diesel fuels, diesel fuel fractions and
25 model fuels in a paper titled THE LUBRICITY OF DIESEL FUELS
(Wear, 111 (1986) 217 - 235). Under test conditions the used,
sulfur-containing components were found to be pro-wear.
Polyaromatic species and, in particular, oxygen-containing
components, were found to reduce wear significantly.

30 Contrary to the position of Examiner, substituting the
oxidation treatment of Malisoff for the second HDS of Hatanaka et

al. does not produce an equivalent result, because as shown above, the oxidation treatment of Malisoff is different in kind from instant claims which include a key step of contacting a high-boiling, sulfur-rich, mono-aromatic-lean, petroleum distillate fraction with
5 an immiscible phase comprising at least one organic peracid or precursors of organic peracid in a liquid phase reaction mixture.

By contrast Applicants' novel process includes a catalyzed, hydrogen peroxide, promoted oxidative desulfurization of a sulfur-rich, mono-aromatic-lean fraction without further production of
10 carbon dioxide or hydrogen sulfides. An additional advantage of Applicants' novel oxidative desulfurization process is that oxidation is selective to sulfur and nitrogen containing heteroaromatic compounds, i.e. does not saturate the non-sulfur, non-nitrogen multi-ring aromatic hydrocarbons.

15 Examiner relied upon the Gore reference of record to disclose treating and recycling the oxidant. However, practice of recycle according to the disclosure of Gore on hydrogen peroxide and acetic acid results in a critical accumulation of a high water concentration. Each mole of hydrogen peroxide used results in formation of mole
20 of water. As water concentration increases, the equilibrium concentration of peracetic acid is reduced, which must decrease the efficiency of the oxidation.

By contrast, Claim 21 recites Applicants' novel process comprising treating at least a portion of the separated peracid-containing phase to remove and at least a portion of the sulfur-
25 containing and nitrogen-containing organic compounds and water contained therein, and thereafter recycling to the reaction mixture at least a portion of the treated peracid-containing phase having a water content of less than 60 percent by volume.

30 Further more, new Claim 26 recites the novel step of contacting at least a portion of the high-boiling feedstock with an

immiscible aqueous phase having a water content of less than 60 percent by volume and comprising at least one organic peracid or precursors of organic peracid, in a liquid reaction mixture maintained substantially free of catalytic active
5 **metals and/or active metal-containing compounds and under conditions suitable for oxidation of one or more of the sulfur-containing and/or nitrogen-containing organic compounds.**

Examiner used the GB reference of record to disclose treatment of a treated oil with an alumina adsorbent. In
10 particular, according to the GB reference an oxidized hydrocarbon material was washed with 2 Normal sodium sulfite and thereafter washed with water to remove residual sodium sulfite, prior to treating the twice washed hydrocarbon material with the alumina adsorbent.

15 Examiner used the Webster et al. reference of record to disclose treatment of an oil obtained from an oxidizing process with an alkaline material as suggested by Webster because a material with a reduced amount of sulfur will be obtained.

Contrary to the position of Examiner, Webster et al. report
20 their thermal treatment in the presence of lime of an oil obtained from an oxidizing process, resulted in a material having a higher level of sulfur than treatment without lime, 2.52 percent sulfur with lime, 2.03 percent sulfur without lime (Webster et al. column 4, lines 25 to 45).

25 Applicants and their undersigned Attorney appreciate Examiner's attention to the arguments of Dr. Gong, previously presented in an affidavit under 37 CFR § 1.132, and further consideration of this matter.

Base on the amendments submitted, herein and previously,
30 and Paper No. 11, an affidavit under 37 CFR § 1.132, Applicants

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urge that Claims 12, 14, 15, 17 to 22, inclusive, 24 and 25, all claims now presented, are in condition for allowance. Applicants respectfully request Primary Examiner Griffin to pass subject application for allowance.

5 Do not hesitate to contact Frederick S. Jerome whose telephone number is (630) 832-7974 (FAX (630) 832-7976) if additional assistance is needed regarding this paper or earlier papers for Applicants.

Respectfully submitted,

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